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The economics of Roscas and intra-household resource allocation*

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Abstract

This paper investigates individual motives to participate in rotating savings and credit associations (roscas). Detailed evidence from roscas in a Kenyan slum (Nairobi) suggests that most roscas are predominantly composed of women, particularly those living in a couple and earning an independent income. To explain this phenomenon, we propose an argument based on conflictual interactions within the household. Participation in a rosca is a strategy a wife employs to protect her savings against claims by her husband for immediate consumption. The empirical implications of the model are then tested using the data collected in Kenya.

JEL Classification Codes: D10, J16, J12

Keywords: Rosca, Gender, Household

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1. Introduction

Rotating savings and credit associations (roscas) constitute one of the most commonly found informal financial institutions in the world, and particularly in Asian and African countries.[1] In these associations, a group of individuals, who typically live in the same community, gather for a series of meetings. At each meeting, each of them contributes a pre-determined amount into a collective 'pot' which is then given to one member. The latter is then excluded from receiving the pot in future meetings, while still being obliged to contribute to the pot. The meeting process repeats itself until each member has received the pot. There is substantial variation among roscas as to the frequency of the meetings, the amount of the contribution, the number of members and the way the order of the winners is determined. In some this process is *random*, determined by drawing lots, in others it is a *bidding* process, through which the pot goes to the highest bidding individual (see Ardener (1964) for a detailed discussion of the various ways to allocate the pot).[2]

In the literature (see, in particular, the empirical analyses by Besley and Evenson (1996) and Evenson and Besley (1996) on Taiwan), roscas are usually viewed as a way for individuals with little or no access to formal credit markets to save up for the purchase of indivisible durable goods.[3] As there is no interest to be gained by saving in a rosca, the question is why do individuals choose to save through a rosca instead of individually accumulating savings? In their seminal contributions, Besley, Coate and Loury (1993 and 1994) argue that, on average, roscas allow individuals to receive the pot, and hence to buy the durable good, earlier than through individual savings. While, *ex ante*, all individuals are thus better off by saving through a rosca, the member who receives the pot last is *ex post* worse off.[4]

This hypothesis however is apparently not supported by the evidence we collected on a sample of 520 households in a Kenyan slum, called Kibera, located on the outskirts of Nairobi. The majority of roscas in Kibera (there are a total of 385 in our sample) do not systematically have a random or bidding order.[5] In most instances, there is a pre-determined order which is known before the

[1] See, for example, Bouman (1977), for a list of countries in parts of Africa, Asia, the Americas, Caribbean, Middle East, and early Europe where roscas have appeared.

[2] Kovsted and Lyk-Jensen (1999) compare the performance and efficiency of the bidding and random roscas.

[3] The work of Handa and Kirton (1999) on Jamaica , van den Brink and Chavas (1997) for Cameroon, and Gugerty (1999) for rural Kenya similarly find evidence that rosca funds are used for durable goods purchase.

[4] In fact, *at least* the last member is worse off (*ex post*) by joining the rosca. This follows because the savings rate (i.e., contribution) imposed by the rosca is feasible for this member if he saves on his own, but typically not optimal.

[5] In contrast, Calormis and Rajaraman (1998) find a prevalence of roscas with concurrent bidding. As a result,

rotation cycle begins. Typically, while the original order might have been chosen randomly, the order of the winners tends to be repeated throughout the cycles: 69.2% of the roscas in our sample do not change their order after a cycle. (The median number of cycles in our sample is 3.2, and the median length of a cycle is 6.1 months.) As a result, at least after one full cycle, there is no randomness in receiving the pot. The rationale proposed by Besley, Coate and Loury (1993) does not apply here since it cannot explain why, after one full cycle, the last recipient would stay in the rosca (and by backwards induction the rosca breaks down).

Another observation from the data is that an overwhelming majority of rosca members are women: 84%. This is unlikely to have arisen randomly and the gender issue in roscas has yet to be investigated.[6]

In this paper we develop a new argument based on intra-household conflict to explain rosca participation. This argument originates from semi-open interviews conducted among women from informal groups in Kibera. In those discussions, women often saw their use of roscas as a way to hide money from their husbands (and possibly other members of the family).[7] For example:

> "Joining a merry-go-round (i.e., a local rosca) is the only way to save some money. If I leave it at home, it will disappear."
>
> "You cannot trust your husband. If you leave money at home, he will take it."
>
> "In our group, we have secret meetings. Members cannot talk outside. There are bad husbands who take the money, and do not provide their wives with food and basic goods ... People quarrel a lot."
>
> "We wanted only women in the group, we are more free, and we can talk and laugh. Men always want to take the lead. They are like children ... They are not interested in improving the situation of the family."

they suggest an insurance role for roscas instead of a device to purchase an indivisible durable good.

[6] There are several other studies which find that predominantly women join roscas. Ardener (1964) points to several case studies where roscas are composed only of women in India, Malaysia, Ghana, South Africa, Sudan, and Egypt. Geertz (1962) also finds that almost all women belong to several rosca groups in Eastern Java.

[7] Confidentiality of discussion and procedures matter a lot in all informal groups. Members are usually not allowed to talk about the groups they belong to with others. Such secrecy is clearly aimed at protecting members against theft or malfeasance, but also to ensure freedom of speech during the meetings, and to avoid the formation of hidden alliances outside the group meetings. In the 44 informal groups we interviewed in some depth, 6 of them have explicit written rules to punish members who violate this obligation (see also Appendix A, section 7.4).

We demonstrate that if men have a greater preference, relative to women, for present consumption than saving for an indivisible good, then women are better off if they save in a rosca than at home. Essentially, roscas provide a forced savings mechanism that the woman can impose on her household. Roscas help to increase the household's saving rate.[8] The household may indeed be willing to purchase the indivisible good *ex post*, when the wife returns home with the pot, even in those cases where, *ex ante*, it was not willing to save at all.

Our theory predicts that income earning women are more likely to save in roscas if they are married. In Kibera, the probability that a woman (18 years and older) participates in a rosca is 40.0%. If she lives in a couple, this probability rises to 53%, while it falls to 25.3 % if she does not live in a couple. When she is working, her participation rate increases to 68.5%, and to 74.4% if she simultaneously lives in a couple. By contrast, the participation rate of a working woman who does not live in a couple is only 54.7%. The participation rate for men is 10.1%, for working men is 12.4% and for working men living in a couple, it is 9.6%.

The paper is organized as follows. The next section provides a model of conflict in the household and derives empirical implications. Section 3 summarizes the data and an empirical test of our theory is subsequently provided. An alternative explanation is discussed in Section 5 and Section 6 concludes.

2. Disagreement in the Household

Consider a household composed of two individuals; husband and wife. The conflict between members of the couple centers around their different preferences for an indivisible good, the purchase of which requires accumulated savings. Assume that, relative to men, women always have a larger preference for the good. As a result, they would like to choose a higher savings rate to purchase the good than men would. (It is also possible that men do not want to purchase the good at all.)

Such a difference in preferences is conceivable for several types of household goods. For a good such as school fees for children, for example, it is likely that women have a larger preference for this good due to gender specific preferences for children. Or men may be more subject to social pressure

[8]Krahnen and Schmidt (1994) in their overview of informal finance in developing countries also note: "But there is another socially valuable function which Rosca members seem to value highly: in many countries and cultures the participation by individuals in such groups creates a senior claim of the participant on resources that otherwise would have been absorbed by the 'sponge' of family needs." (Krahnen and Schmidt, 1994: 47). This is exactly the claim we want to investigate here.

to transfer money to outside family members, or to reveal status by conspicuous consumption, which both reduce their incentive to save relative to women. Bruce (1989) cites numerous case studies, throughout the developing world, which illustrate the tension within households over the use of income. Most studies find that childrens' well-being is strongly correlated with women's income relative to men's, where women consistently devote a higher proportion of their income to family needs than do men. Men withhold a proportion of their income for personal use, even when families live in or near poverty. Bruce notes that these gender-based differences are most explicit in Africa, where it is commonly believed that men have a right to personal spending money, which they are perceived to need or deserve, while women's income is used for collective purposes. The work of Hoddinott and Haddad (1995) empirically verifies the claim of numerous case studies of African households that, relative to women, men spend a greater proportion of their income on goods such as alcohol and cigarettes, whereas women are more likely to purchase goods for children and for general household consumption.[9] In the same vein, Thomas (1990) finds that unearned income in the hands of a mother has a bigger effect on a family's health than when under the control of the father; for child survival probabilities the effect is roughly twenty times larger.

Although husbands and wives typically earn independent incomes, the difference in savings patterns induces a potential conflict, as household decision making is joint. As a result, a woman is forced to choose a savings rate lower than her optimum. By contributing to a rosca instead of accumulating at home, a woman prohibits her husband from spending her savings by rendering them illiquid. Once a woman has committed to a contribution schedule, sanctions prevent her husband from forcing her to renege on this contract. Firstly, roscas typically do not reimburse past contributions of defaulting members. (Since a man is unlikely to know when his wife initially joined, realizing this too late, it is a *fait accompli*.) Second, social sanctions and the loss of reputation for his household may prevent him from benefiting from other community-based institutions.[10] Moreover,

[9]Differential spending patterns across genders is not limited to developing countries. Browning et. al. (1994) and Phipps and Burton (1993) show this to be the case for Canadian men and women and Bourguignon et. al. (1993) obtain similar results for French households.

[10]In Kibera, such social sanctions give the defaulting member a 'bad name'. As information spreads quickly in the slum, such a sanction effectively implies that he loses access to other informal groups. Indeed, new membership is never automatically granted, it is a decision taken by the general assembly of all members. It is usually preceded by (i) a discussion among all members about the new applicant, (ii) an enquiry and application approval by the governing body, and, often, by (iii) the acceptance by a member to sponsor the new applicant, for a specified period of time. If the applicant/new member defaults during this period, the sponsor is financially responsible for all of the obligations (due contributions, repayments, membership fees, etc.) the defaulting member has contracted towards the group. Such schemes illustrate the degree of care exercised by these groups, which makes 'social sanctions'

as there are a large number of roscas, we assume here that the she can choose the amount of the contribution, by choosing the appropriate rosca(s).

Notwithstanding these motives to join a rosca, the rationale is less transparent given that the pot is eventually taken home[11]. At this point, the husband has access to the money and may well decide to spend it on a purchase, other than the indivisible good. We present a simple model to characterize the conditions under which, though this is feasible, the man chooses not to expropriate the pot, even though he would expropriate the contributions if he could. In such a scenario, a man is made worse off, *ex ante,* by his wife's decision to join although he is *ex post* in accordance with her plan to purchase the good.[12]

2.1. The model

Formal borrowing opportunities are not available, so the only means of saving is either through direct storage or through a rosca. We introduce a simple household model which incorporates the above conflict by assuming that woman have a greater preference for an indivisible good than their husbands. In a period in which the indivisible good is not purchased, the utility of a woman at time t is represented by the following utility function:

$$U_t^w = u(c_t) \tag{2.1}$$

where c_t is current consumption by the household in period t and $u(\cdot)$ is increasing and concave. Her utility in a period where the indivisible good, D, is purchased is given by:

$$U_t^w = u(c_t) + D \tag{2.2}$$

We assume here that the indivisible good yields services in only one period.[13]

particularly effective. Note also that in many roscas, a new member is often given the last number for some cycles, in order to test his/her trustworthiness (for more details, see Baland and Platteau (2000)).

[11]Some roscas directly purchase goods for the members (see Appendix A, section 7.1). However, for more than 90% of roscas in our data, money is directly given to the member instead of an in kind transfer. Even then, the use of the money is often overseen by the group, as illustrated in Appendix A (section 7.3, art. 13.c).

[12]Given this, there is the question as to why sellers (or schools) cannot accumulate the women's savings for her instead of a rosca. There are several reasons for why this may not be the case, such as inflexibility in the expenditure that such a scheme implies (for example, in case of an unexpected shock, one cannot change the nature of the good which will be purchased) and trust in an unfamiliar agent (and, if the buying of more than one good is considered, it requires trust in a corresponding number of traders). Additionally, the Besley et. al. argument still holds for at least some people who receive the pot earlier each cycle.

[13]An alternative specification, used in Besley et. al. (1993), considered that services yielded by the indivisible good extend to more than one period. The results discussed here are, however, robust to such a specification.

Similarly, the utility of a husband at time t is defined as:

$$U_t^h = u(c_t) \tag{2.3}$$

and,

$$U_t^h = u(c_t) + \delta D \tag{2.4}$$

in a period where the indivisible good is purchased, where δ represents his relative preference for the indivisible good. We assume that $\delta < 1$ to reflect his lower preference for the indivisible good than his wife. Note also that, for expositional simplicity, we assume husbands and wives have identical preferences with respect to present household consumption. We thus abstract from issues arising from conflict over current consumption across family members, to better focus on the conflict arising from differential preferences over the household indivisible good. Our argument would *a fortiori* hold in such alternative settings, but with more complications. We also normalize the cost of D to equal one.

The husband and wife jointly decide whether or not to purchase the indivisible good, and thus choose the optimal household saving rate, $s_t^{H*} \geq 0$, by maximizing a weighted sum of their individual utilities:

$$\mathcal{U}^H = \sum_t \Delta^t U_t^H = \sum_t \Delta^t \left((1-\gamma) U_t^h + \gamma U_t^w \right) \tag{2.5}$$

At time t, the utility of the household is thus given by :

$$U_t^H = ((1-\gamma)\delta + \gamma) D + u(c_t) \tag{2.6}$$

in a period in which the indivisible good is purchased, and

$$U_t^H = u(c_t) \tag{2.7}$$

otherwise. The discount factor, Δ, is smaller than one, and γ, where 0□ γ □ 1, represents the weight given to the wife's welfare in the household joint decision making. In each period, the household budget constraint is given by:

$$Y^w + Y^h = c_t + s_t^H \tag{2.8}$$

where Y^w and Y^h are the income received by the wife and her husband respectively each period, and s_t^H is household savings in period t with $s_t^H \geq 0$. The incomes, Y^w and Y^h, are assumed to

remain constant throughout their lifetimes. Additionally, if the indivisible good is purchased, the accumulated savings must at least cover its cost:

$$\sum_{t}^{T^H} s_t^H \geq 1 \tag{2.9}$$

where T^H represents the purchase date.

If the household purchases the indivisible good, the saving pattern $\left\{s_t^{H*}\right\}$ satisfies the following first order condition:

$$\frac{u'(c_t)}{u'(c_{t+1})} = \Delta, \tag{2.10}$$

which implies that savings, when positive, are increasing through time: $s_t^{H*} \prec s_{t+1}^{H*}$, for all $t < T^H$.

Given this, the household will decide to save to purchase the durable good provided there exists a saving pattern $\{s_t^{H*}\}$, which satisfies equations (2.9) and (2.10) and such that:

$$\sum_{t=0}^{T^H} \Delta^t u(Y^w + Y^h - s_t^H) + \Delta^{T^H}((1-\gamma)\delta + \gamma)D + \sum_{t=T^H+1}^{\infty} \Delta^t u(Y^w + Y^h) \geq \sum_{t=0}^{\infty} \Delta^t u(Y^w + Y^h) \tag{2.11}$$

If this condition is not satisfied, the household is better off not saving for the durable good and $s_t^{H*} = 0$ for all t.

2.2. Rosca participation decision

We now introduce the possibility of saving through a rosca. We assume that the woman takes the household decision described above as given, and chooses whether to participate in a rosca or not. The structure of the game is as follows:

- Stage 1: the woman chooses her contribution to the rosca in each period t, $0 \square s^R \square 1$ and the duration of the rosca, T^R. (If she decides not to participate in a rosca then, $s^R = T^R = 0$.)
- Stage 2: the husband and wife jointly choose household savings in each period t, $s_t^H \geq 0$.
- Stage 3: when $t = T^R$, the women receives the pot and the household decides its use.

There are two main situations to be distinguished. The first is the one in which the household *ex ante* is willing to save in order to buy the good, that is condition (2.11) holds. The second case is when, *ex ante*, the household is not willing to save for the good. We focus now on the first

scenario, to derive the main results of the model. The second case will be considered at the end of this section.

Assume first that the woman has access to total household income when choosing whether to participate in a rosca. We explicitly address the case where she has only the use of her own income later in this section. Note that, when condition (2.11) holds, the woman necessarily has an incentive to save since she has a higher preference for the durable good. Therefore, there exists an optimal sequence $\{s_t^w\}$ such that ,

$$\sum_{t=0}^{T^W} \Delta^t u(Y^h + Y^w - s_t^w) + \Delta^{T^w} D + \sum_{t=T^W}^{\infty} \Delta^t u(Y^h + Y^w) > \sum_{t=0}^{\infty} \Delta^t u(Y^h + Y^w). \tag{2.12}$$

The saving pattern the household jointly chooses is always smaller than $\{s_t^w\}$.

Lemma 1. *Since $\delta < 1$, $s_t^w > s_t^H$, $\forall t$, and $T^w < T^H$, where T^w represents the date at which her accumulated savings equal one.*

As the household is willing to save on its own to buy the indivisible good, it is clear that, if the woman, at one point in time, has enough accumulated savings to buy the good, the household will use them to purchase the indivisible good rather than increase present and future consumption. Moreover the household may contribute additional savings to those saved in the rosca. The woman takes this into account when she chooses her optimal rosca contribution. We now formulate this problem.

If a woman chooses to join a rosca[14], and saves an amount $s^R \geq 0$, the household may decide to add extra savings, σ_t^H, with $\sigma_t^H \geq 0$. The household problem is then as follows.

$$Max_{\sigma_t^H} \left\{ \sum_{t=0}^{T^R} \Delta^t u(Y^h + Y^w - s^R - \sigma_t^H) + \Delta^{T^R}((1-\gamma)\delta + \gamma)D + \sum_{t=T^R+1}^{\infty} \Delta^t u(Y^h + Y^w) \right\} \tag{2.13}$$

such that $1 = \sum_{t=0}^{T^R} \left(s^R + \sigma_t^H \right)$.

[14]We also assume that a woman always has a motive to save, i.e., she always prefer to join a rosca than not to save, that is, there exists s_R such that $\sum s^R = 1$ and

$$\sum_{t=0}^{T^R} \Delta^t u(Y^h + Y^w - s^R) + \Delta^{T^R} D + \sum_{t=T^R}^{\infty} \Delta^t u(Y^h + Y^w) > \sum_{t=0}^{\infty} \Delta^t u(Y^h + Y^w).$$

Given this problem, the woman decides whether or not to join a rosca and the amount of her contribution by solving the following problem. She chooses s^R such that:

$$Max_{s^R}\left\{\sum_{t=0}^{T^R}\Delta^t u(Y^h+Y^w-s^R-\sigma_t^{H*})+\Delta^{T^R}D+\sum_{t=T^R+1}^{\infty}\Delta^t u(Y^h+Y^w)\right\} \tag{2.14}$$

where σ_t^{H*} solves (2.13).

First consider the decision of the household. As household utility is time separable, the optimal amount of savings at time t depends only on the amount of accumulated savings $S_t : s_t^H = s^H(S_t)$. As a result, for a given S_t, the additional savings σ_t^{H*} that the household chooses to contribute is equal to the difference between the optimal household savings $s^{H*}(S_t)$ and s^R, provided $s^{H*}(S_t) > s^R$; otherwise $\sigma_t^{H*} = 0$. Thus, after the point where $s^{H*}(S_t) \geq s^R$, the household will contribute additional savings. Moreover, condition (2.10) implies that σ_t^{H*}, when positive, is increasing at an increasing rate. Lastly, as the woman's optimal saving pattern, s_t^{w*}, also satisfies condition (2.10), if there exist t and t' such that $s_t^{w*} = s_{t'}^{H*}$, then $s_{t+1}^{w*} = s_{t'+1}^{H*}$ and all consecutive savings are also equal. (This property will be useful for Figure 1 below).

Turning to the woman's decision problem, we focus on the determination of her rosca contribution s^R. Consider her optimal saving pattern in the absence of a rosca, s_t^{w*}. Necessarily $s^R < s_{T^w}^{w*}$, since otherwise, a woman would be oversaving in all periods. It is also the case that $s^R > s_0^{w*}$, since rosca contributions are constant across time and s_t^{w*} is increasing in t. This holds even if $\sigma_t^{H*} > 0$, since, given any S_t, $s_t^{w*} > s_t^{H*}$. As a result, if $s^R < s_0^{w*}$, then necessarily $s^R + \sigma_t^{H*} < s_t^{w*}$ and a woman would be systematically undersaving compared to her optimal saving plan. Therefore, if a woman joins a rosca, her rosca savings satisfy $s_0^{w*} < s^R < s_{T^w}^{w*}$. Moreover, as the household saves less than she would like, she always has an incentive to join a rosca, as the resulting saving schedule is closer to her own, i.e., she is at least better off by choosing $s^R = s_0^{w*}$, but she can even do better by choosing a higher s^R. Therefore,

Proposition 1. *If condition (2.11) is satisfied, a woman always joins a rosca and* $s_0^{w*} < s^R < s_{T^w}^{w*}$.

The diagram below, where we use a continuous time approximation, illustrates this proposition.

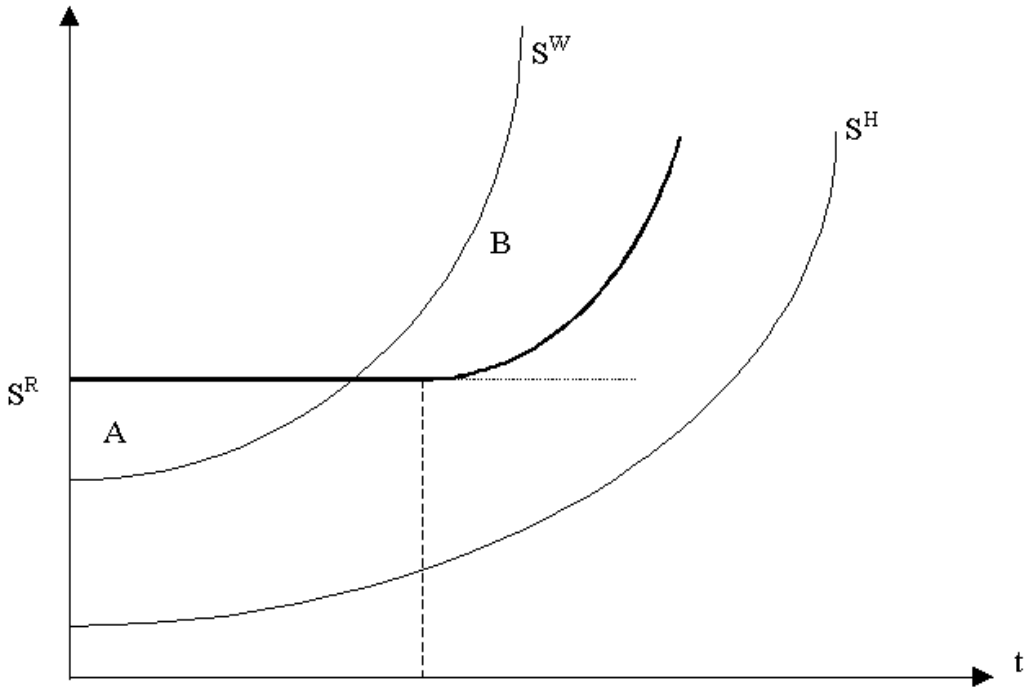

Figure 1: Rosca contributions and optimal saving schedule

The two optimal saving schedules, in the absence of a rosca, are represented by the curves denoted s_t^w and s_t^H. Note that the shape of these curves is identical after the point at which $s_t^H = s_0^w$. The bold line represents the household total saving schedule $(s^R + \sigma_t^H)$ when the woman joins a rosca. Given $s_0^{w*} < s^R < s_{T^w}^{w*}$, let t' be the point at which $s^R = s_{t'}^{w*}$. As roscas imply a rigid contribution schedule, the trade-off a woman faces when joining a rosca is between her oversaving in the first periods, until period t' (area A), and her undersaving thereafter (area B). Note also that, once the household contributes additional savings, σ_t^{H*}, total household savings are upward sloping.

The welfare implications are immediate: a woman is better off by joining a rosca and her husband is worse off, compared to the situation prevailing when she does not join a rosca. This holds as long as the household is the last to receive the pot. As the potential conflict in the family is more severe the later the pot is received, if, by chance, the household is the first to receive the pot, both husband and wife are better off. In other words, when the order of the rosca is known, husbands'

welfare may increase with rosca participation provided the order is favorable enough.[15]

We now turn to analysing the role of changing parameters on the rosca participation and saving decisions. We begin by focusing on the impact of a change in a woman's weight in household decision making, γ. A higher γ does not affect a woman's saving schedule, s_t^w, but increases the household propensity to save. In the diagram above, a higher γ thus causes the s_t^H schedule to shift upwards. Assume first that γ is high enough so that σ_t^{H*} is positive for some t. As γ rises for a given s^R, the household contributes larger additional savings. She anticipates this when choosing s^R and decreases her rosca savings accordingly, thereby, reducing the oversaving bias in the initial periods (i.e., area A in the above diagram). The saving schedule of the household becomes closer to her own and s^R is decreasing in γ. By contrast, when γ is low, the household may decide never to contribute additional savings. (This is necessarily the case if $s_{T^H}^{H*} \square s_0^w$). In this case, as γ decreases, there is no impact on s^R, i.e., s^R remains constant. Identical reasoning follows through when δ, a husband's relative valuation for the durable good, increases.

Proposition 2. *If a household is ex ante willing to save, the rosca contribution chosen by the woman is non-increasing in her weight in household decision making, γ. It is strictly decreasing for high enough values of γ.*

Let us now consider the situation in which the household is not willing *ex ante* to save. First, it may be the case that, even though it is not willing *ex ante* to save, if given a high enough stock of accumulated savings, it may decide to save in future periods instead of consuming those savings. In other words, there exists a stock of savings, S_k, and household savings path, s_t^H, where $0 < S_k < 1$ and $\left\{s_t^H\right\} > 0$, such that,

$$\sum_{t=0}^{T^H} \Delta^t u(Y^w + Y^h - s_t^H) + \Delta^{T^H}((1-\gamma)\delta + \gamma)D + \sum_{t=T^H+1}^{\infty} \Delta^t u(Y^w + Y^h) \geq \sum_{t=0}^{\infty} \Delta^t u(Y^w + Y^h + m_t^*) \tag{2.15}$$

[15]Some may argue that households, even when husbands and wives have conflictual objectives, should agree on some Pareto-efficient outcome, as most conditions for efficient contracting are fulfilled. However, that household decisions may not always be efficient is discussed in Lundberg and Pollak (1996). Udry (1996) provides strong empirical evidence that the household allocation of resources between male and female-controlled plots in Burkina Faso is not efficient. In our case, although the husband is potentially worse off when his wife joins the rosca, he cannot offer her a credible alternative contract, since he would be tempted to renege and renegotiate on any saving path he offers her. Moreover, it is not clear that, in any period, the woman can costlessly join a rosca corresponding to her preferred contribution. As a result, chosing not to join the rosca in the current period, on the basis of her husband's promises, renders her too vulnerable in the following periods.

where m_t^* corresponds to the optimal dissaving pattern, $S_k + \sum_{t=0}^{T^H} s_t^H = 1$, and $\sum m_t^* = S_k$.

In other words, given sufficient accumulated rosca savings, the household will decide to save to buy the durable good, instead of consuming it through an optimal dissaving pattern m_t^*. It may even decide to contribute additional extra savings to the amounts thus accumulated. As a result, the situation here is essentially the same as the previous case where the household was *ex ante* willing to save (a situation which is reached by letting S_k tend towards zero). While for very low levels of γ, the household may not be willing to add savings to the rosca contributions, beyond a given threshold, as γ increases, the household is increasingly inclined to contribute additional savings, which in turn reduces the woman's rosca savings.

However, it is clear from equation (2.15) above that, as γ falls, the minimal amount of accumulated savings, S_k, increases. When S_k reaches one, the household will agree to spend the pot on the durable good in the last period. But as γ further falls (for adequately low values of δ), even if the pot is equal to one, the household prefers to spend it on consumption than on the durable good.

However, it is possible that, if accumulated savings exceed one, the household chooses to buy the durable good and spends the excess savings on consumption. In other words, there exists $S_k > 1$ and $c_t^* \geq 0$ such that,

$$((1-\gamma)\delta + \gamma)D + \sum_{t=0}^{\infty} \Delta^t u(Y^w + Y^h + c_t^*) \geq \sum_{t=0}^{\infty} \Delta^t u(Y^w + Y^h + m_t^*) \tag{2.16}$$

where $\sum c_t^* = S_k - 1, \sum m_t^* = S_k$, and c_t^* represents the optimal dissaving plan when the household buys the durable good, and m_t^* when it does not. If the condition above holds, the woman can thus convince her husband to purchase the durable good provided she brings home enough accumulated savings. The household never adds voluntary savings on its own, and the rosca 'pot' is spent on the durable good and on increased consumption. The size of the pot to be brought home is larger the lower the woman's weight in the household decision making process. Note also that γ may be so low (with relevant values of δ) that the condition above is not satisfied, and, whatever the size of the pot brought back home, the household will always choose to spend it on consumption and not buy the durable good. More importantly, as the size of the pot, and thus the savings accumulated through the rosca, becomes large, the woman finds this plan of accumulating savings through the rosca less and less attractive. At the extreme, as the pot to be brought home becomes arbitrarily

large, she will prefer to spend on current expenditures than embarking on this costly saving process. There is thus a threshold value of γ, below which the woman will decide not to save, given that the amount of savings to be accumulated and brought back home to convince her husband to purchase the good is too large.

2.3. Empirical predictions

The central implication of our theoretical analysis is that a woman's participation in roscas is a strategy she employs to protect her income against claims by her husband for immediate consumption and, thus, to bias household choices towards her own preferences. According to her weight in household decision making, γ, we thus have the following possibilities (for low enough values of δ):

1. γ very small: whatever the amount accumulated, the household does not want to buy the durable good, or the saving process implied is too costly for the woman. Rosca savings are zero and the woman does not join the rosca.

2. γ small: the woman needs to bring home a large amount of savings to convince her husband (condition (2.16)). The size of the pot to be brought home is decreasing with γ.

3. γ medium: while the household *ex ante* would not save, it agrees *ex post* to buy the durable good provided some savings are already accumulated (condition (2.15)). If it does not add some extra saving in the last periods, the rosca contribution does not vary with γ. Otherwise, the rosca contribution is decreasing in γ.

4. γ large (Proposition 2): the household is willing *ex ante* to buy the durable good (condition (2.11)), but the woman uses the rosca to increase the saving rate in the family. Her rosca contribution decreases with γ unless the household is still not willing to add extra saving to the accumulated contributions. However, there is a value of γ above which, the household always contributes some additional saving. As a result, for γ close to 1, s^R decreases in γ.

So far we have assumed that a woman has access to total household income. Consider instead that she only has access to her own income. If her income is smaller than s_0^H, clearly participating in a rosca is not worthwhile as it will not affect the saving pattern of the household. If her income lies between s_0^H and her optimal rosca contribution, she will join rosca and save all her own income. In this range, rosca savings are linear in the woman's income. Lastly, her income constraint is not binding when $Y^w \geq s^R$.

We are now in a position to state our main empirical predictions. To this end, there are three relevant considerations. First, for a given level of household income, there are good reasons to assume that a woman's weight in household decision making is positively related to her individual income or, more precisely, to her share in household income, α, where $\alpha = \frac{Y^w}{Y^w+Y^h}$. Second, for the households under consideration, it is likely that women only have access to their own income. Third, participation in a rosca also implies some fixed cost in terms of meeting attendance and other social obligations towards the other members of the group.[16] As a result, joining the rosca will be worthwhile only if the expected benefits are large enough to cover these costs. Therefore, if we want to analyse the impact of a woman's relative income on her rosca participation and contribution decisions, three effects come into play: the income constraint on her contribution, her weight in household decision making, and the fixed cost of participating in a rosca.

For very low levels of α, a woman's income is so low that she does not join the rosca but will start to join for α high enough. We also expect that when a woman's bargaining power, which increases with α, is very high, the household savings decision does not differ much from her own, and she will not join the rosca. Thus, for very high and very low levels of α, the woman decides not to join a rosca. In this sense, we would expect that:

Conjecture 1. *The relationship between the probability of joining a rosca and female relative income share, α, is an inverted-U shape.*

Moreover, the woman's rosca contribution first increases linearly with her income, as long as her income constraint is binding. Once it is no longer binding, then the only impact of α is through γ and therefore:

Conjecture 2. *Rosca contributions are non-increasing in α, and even strictly decreasing for α high enough.*

This empirical prediction can be illustrated with the help of the following diagram:

[16] In most roscas, it is not necessary for members to be present when they make their contributions, as the treasurer is usually in charge of visiting each member to collect the funds. However, general assembly meetings, typically scheduled once a month, are important social occasions and last 3 to 4 hours (including greetings, praying, drinking tea, etc.). Members who do not attend can be fined and repeated absence can lead to exclusion (see Appendix A for details).

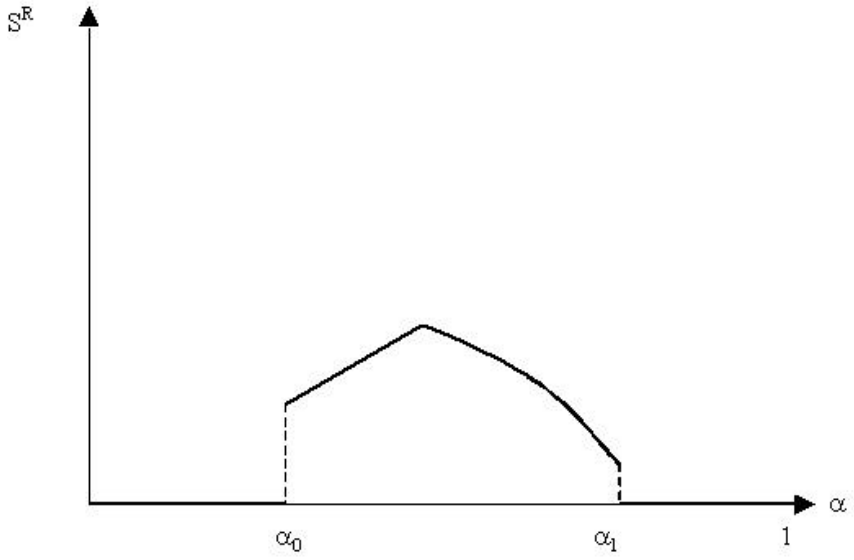

Figure 2: Rosca contributions as a function of woman's share in household income

We can test for these direct implications. To this end, there are several components of a woman's weight in household decision making that should be related to her rosca participation. Most importantly, rosca contributions and participation decisions are highest for average levels of a woman's relative share of household income, and lowest for very high and very low levels of the latter. Relatedly, women who work are arguably more likely to participate than those who do not (recalling that these are households who are essentially below the poverty level and hence the fact that higher status women can afford not to work should be irrelevant), particularly relative to their husband's employment status. While household income should matter for the amount contributed to roscas, it should have less (or no) impact on the decision to participate, once female weight in household decision making is properly controlled for. Lastly, while gender and marital status should be strong predictors of rosca participation, they should have no effect on the amount of rosca contributions.

We have motivated our explanation for rosca participation by our empirical findings of predominantly non-random roscas where the majority of participants are married women. The Besley et. al. explanation relies on the fact that there is randomness to receiving the pot and suggests that all individuals have a motive to join a rosca and hence cannot explain the demographic component

of rosca participants. However, ignoring the issue of randomness, it may well be the case that the Besley et. al. explanation is an additional motive for women to join roscas. That is, women want to impose a higher savings rate on the household by joining a rosca (as our analysis suggests) but also receive the benefit of receiving the pot earlier than if they had saved at home. If this is the case, then our empirical prediction of an inverted-U shape relationship between female bargaining power and rosca participation will not ensue. That is, although woman with a very low income share will not join a rosca since the costs are too high, at very high levels of bargaining power they will join a rosca. Since there exists the additional benefit of receiving the pot earlier they always have the motive to do so.

3. Description of the data

The data used in the estimation were collected in 1996-7 in the slum of Kibera which is situated on the outskirts of Nairobi and is one of the largest in Kenya. It extends over 225 hectares of land and houses a population of approximately half a million people. The inhabitants are very poor. They live with enormous risks to their health and income, with no access to formal insurance or credit institutions. There is little intervention by the State to improve the well-being of the slum population. As a result, individuals are left to their own devices to satisfy their most basic needs. These circumstances have given rise to the formation of numerous informal credit groups such as roscas, health insurance groups, funeral groups, saving and credit groups, and collective investment groups.

We interviewed 520 households, all living in the same area of Kibera, namely the village of Kianda. Households, selected through a random process, were interviewed over the course of 4 months during the spring of 1997. All household members were first surveyed for information on their education, work activity, and income. Households expenditures were carefully recorded over a week, with frequent visits by one of the enumerators. During the second round, each member was asked detailed information on all informal groups which they belong to. From this process, we collected information on 620 groups, of which 385 were roscas.[17] (We carried out separately

[17]One fourth of the roscas in the sample perform additional functions, such as health insurance schemes, long term investment projects, and self-employment schemes (see Appendix A, section 7.2 for an example). Such functions are almost always clearly demarcated from the rosca itself: typically, rosca contributions are distinct from contributions to the other activities of the group, and payments for the former are often made along a different pattern than payments for the latter. As a result, we have decided to consider all groups with a rosca as one of their activities in

semi-open interviews with the governing bodies of 44 informal groups, to obtain more precise information on their internal functionings.) The following table lists some background information on these roscas:

Variable	**Mean**
Number of members	15.77
Months existed	27.80
Contribute every day (% of roscas)	0.10
Contribute every week	0.35
Contribute every 2 weeks	0.06
Contribute every month	0.49
Length of cycle (median, in months)	6.07
Number of cycles (median, in lifetime of rosca)	3.21
Group comprises only women (% of roscas)	0.65
Group comprises only men	0.06
Group comprises both men and women	0.30
All members are same ethnicity	0.37
Order is unchanged each cycle	0.69
Started group with friends/relatives/neighbors	0.85
Group has secondary role (investment/insurance)	0.25

Table 1: Basic information on roscas

Implicit in our theory of rosca participation, and in the rest of the literature, is that a rosca serves as a saving mechanism in order to purchase an indivisible good. An empirical prediction of this relationship, as Besley and Levenson (1996) have investigated with data from Taiwan, is that, controlling for income, households who participate in roscas exhibit higher ownership rates (or expenditure levels) of durable goods. This is supported (for most income levels, expenditure and ownership were higher) in our data for most indivisible goods and some of the results are presented in the graphs below[18]:

our sample. The alternative would have been to consider groups which are only roscas, but this could have led to a serious bias. In particular, in the survey, all possible alternative functions of the groups were carefully mentioned, even when the latter was clearly of secondary concern for the respondent.

[18]Note that the relationship is not well supported for samples that were extremely small (such as camera ownership) and for some goods for which close substitutes exist, such as charcoal burners and gas cookers. The relationship is well supported for 12 out of 18 durable good categories.

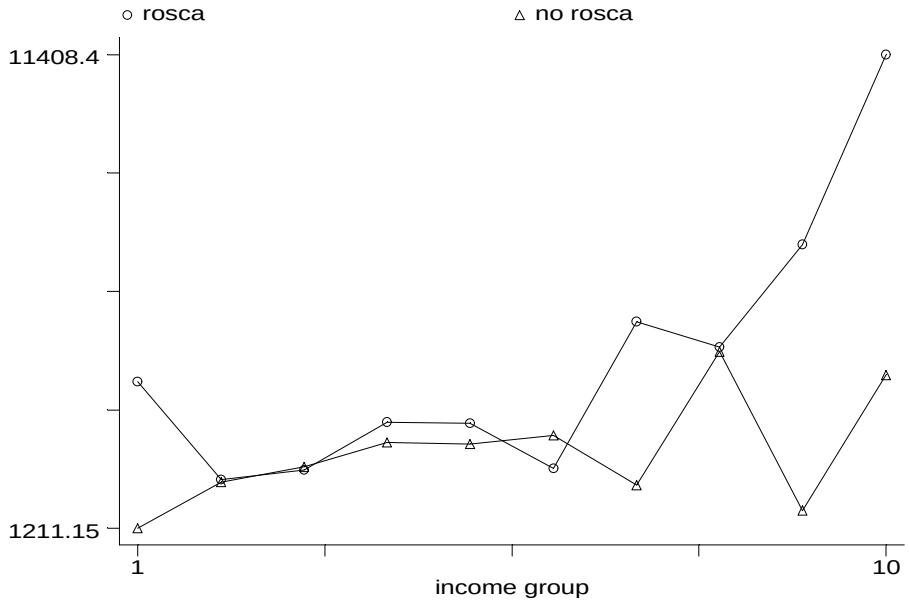

Figure 3: Rosca participation and school expenses

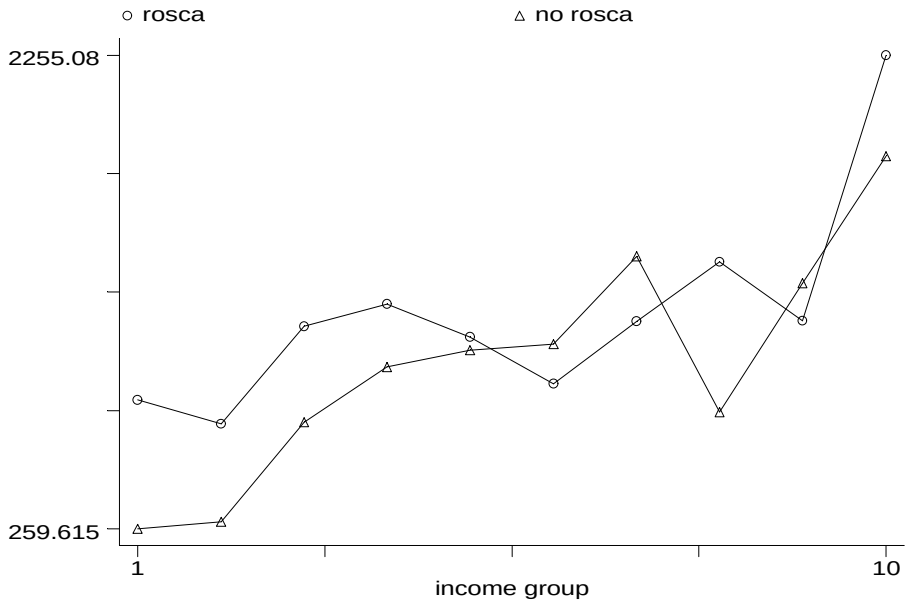

Figure 4: Rosca participation and clothing expenses

Out of all the indivisible expenditures, school fees are the largest expenditure: school fees account for 36% of total non-food expenditures, other large expenses include rent at 22%, clothing

at 18%, and medical costs at 12%.[19] This coincides with the notion that women are saving for their children and the household well-being. Let us briefly examine the broad characteristics of the individuals who participate in roscas. The 520 households interviewed represent approximately 2300 individuals. After omitting all individuals aged less than 16 years, we are left with a sample of roughly 1300. A table of summary statistics is listed below.

	All sample		Rosca members		Women in roscas		Women not in roscas	
Variable	Mean	S.E.	Mean	S.E.	Mean	S.E.	Mean	S.E.
Participates in a rosca	0.25	0.44	1		1		0	
Total monthly rosca contribution	0		702	821	686	835	0	
Female	0.53	0.50	0.84	0.37	1		1	
Age	29.4	9.6	32.5	8.4	32.16	8.32	25.05	8.96
Married	0.59	0.49	0.71	0.46	0.70	0.46	0.42	0.49
Earns labor income	0.58	0.49	0.76	0.43	0.73	0.45	0.30	0.46
Has at least primary school	0.57	0.49	0.47	0.50	0.44	0.50	0.49	0.50
Monthly individual income if work	5389	5406	5290	6714	5019	7115	3182	3546
Household monthly income	8009	9207	8370	9456	8998	9330	8030	9337
Monthly food expenditures	5250	3031	4976	2761	5030	2787	5377	3038
Monthly luxury expenditures	368	723	367	700	324	670	307	665
Monthly children expenditures	1761	2550	1862	2902	1892	2778	1867	2598
Household size	5.05	2.14	4.8	2.1	4.96	2.01	5.20	2.12
Number of children	2.21	1.63	2.3	1.6	2.41	1.55	2.24	1.57
Years in Kibera	7.60	6.19	7.96	5.84	10.01	7.07	8.77	7.63
Native language: kikuyu	0.23	0.42	0.24	0.43	0.26	0.44	0.26	0.44
Native language: luhya	0.18	0.39	0.17	0.38	0.17	0.37	0.19	0.39
Native language: luo	0.40	0.49	0.38	0.49	0.40	0.49	0.35	0.48
Native language: kamba	0.06	0.23	0.07	0.26	0.05	0.22	0.05	0.22
Native language: kisii	0.10	0.30	0.10	0.29	0.08	0.27	0.09	0.29
Number of observations	1269		324		271		406	

Table 2: Characteristics of the population, rosca participants, female rosca participants and non-participants

The most noteworthy differences between the first two columns are that the proportion of individuals who are female, working, and married are much larger for rosca participants than for the average individual in the sample. By contrast, the average number of children and the average income level are the same across the two groups. Expenditure on children is slightly higher among

[19] School fees in this area are paid as a lump sum, usually each semester. Some delays in the payment of the fees are typically allowed by the school administrators, which help parents to schedule the payments according to their turn in the roscas.

those who belong to a rosca. The next two columns illustrate the differences between women who join roscas and those who do not. Most notably, while women in the two groups enjoy a comparable total household income, women participating in roscas, on average, tend to be married, work more often, and earn a higher individual income. They are also older and have lived in Kibera for a longer time. By contrast, the number of children, household size, ethnic background (represented by native language), education levels and expenditures patterns do not differ much between the two groups.

Our theory predicts that gender should be a significant determinant of rosca participation, but, more importantly, if a woman belongs to a couple then she should be more likely to join a rosca. These implications are supported by the raw data as is evident from the table above. Additionally, our analysis predicts that a woman with a higher bargaining position within the household, relative to her husband, is more likely to join a rosca and pay higher monthly contributions. |In particular, an inverted-U shape relationship between female's share of couple income and both rosca participation and contribution is predicted.[20] Plots from the raw data support this inverted-U relationship. The plots below are constructed using the average rosca participation and contributions across married females within five different income share groups. The percentage of married women in each share group are as follows: 51% have an income share of 0%; 5% have a share larger than 0% and smaller than or equal to 20%; 24% have between 20% and 40%; 15% have between 40% and 60%; 2% have between 60% and 80%; and 4% have greater than 80%.

[20]The main estimations of the paper thus include female's share of couple income as a regressor. We also run the estimations using alternative measures of household power, such as the work status of females and their individual income, the results of which are presented in Appendix B and discussed at the end of this section.

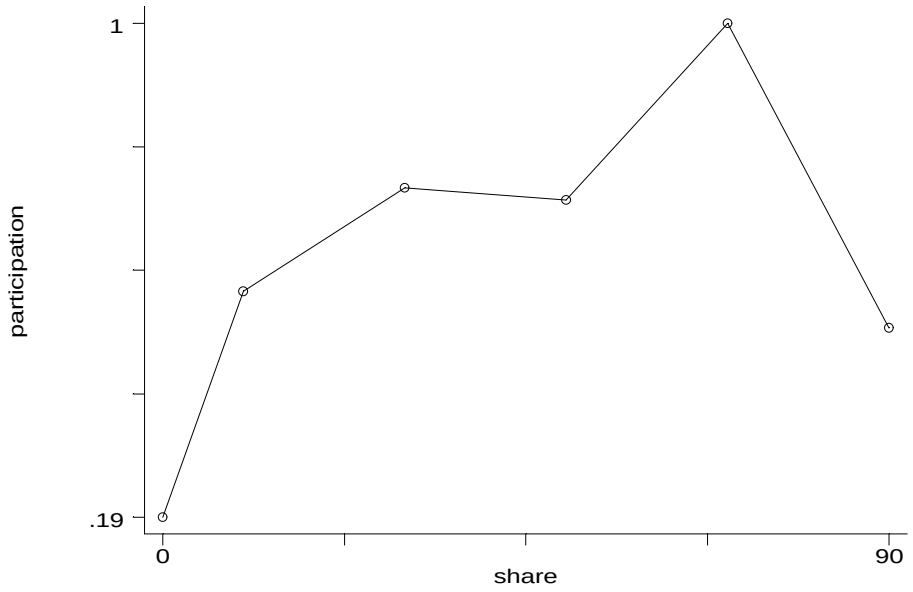

Figure 5: Female income share vs. rosca participation[21]

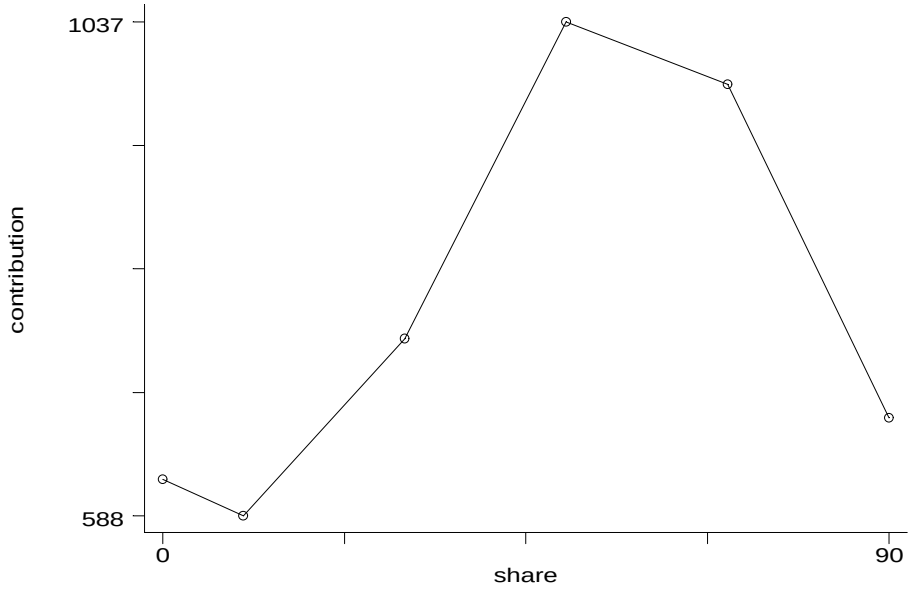

Figure 6: Female income share vs. rosca contribution

[21]The shares corresponding to the points on the graph are the middle percentages of the relevant income share group.

4. Empirical estimates

We examine the implications of our model by estimating two main equations: the probability that an individual participates in a rosca, and their monthly rosca contribution. We allow for the possibility that the estimation of total rosca contributions is not independent of the probability of joining a rosca. The two-stage Heckman procedure is used to control for this potential sample selection bias. We alternatively could have used a Tobit estimation where it would have been implicit that a zero rosca contribution is equivalent to choosing not to participate in a rosca. This procedure seems somewhat restrictive given that the decision to join a rosca can be a separate phenomenon to simply making very small contributions. This coincides with our discussion above, where women must go against their husbands wishes to join a rosca and also generally incur a fixed cost in terms of meeting attendance.[22]

The following table reports the results from a probit estimation of the probability that an individual belongs to at least one rosca group. Since the functionings of roscas depend heavily on the trustworthiness of its members, both native language and years spent in Kibera enter into the estimation. These variables are used to proxy for individuals' trust in one another; as either they share a common culture or sufficient time has elapsed to establish such bonds with other residents. Additional regressors include the number of children, where a larger number should increase the need to join a rosca. Household income should also be positively related to rosca participation, in the sense that there exists the means by which to do so. However, it is easily argued that household income is endogenous to rosca participation. Moreover, rosca contributions form a share of total monthly income, on average equal to 13.3% of total income. To avoid this problem, we use food expenditure to represent the wealth position of the household, which is independent of durable good expenditure. Alternative estimations which include total income directly are listed in Appendix B, where it can be seen that the main results are unaltered.[23] Additional individual characteristics are included in the estimation, such as age and education. The first estimation includes married female's share in the income of the couple and its squared term (if an individual is either single or

[22] It is worthwhile to note that our main results are essentially unchanged in a Tobit estimation.

[23] Total income in these estimations include net transfers. Additional estimations were run with total income excluding net transfers and transfers entering into the regression independently of income. The results for total income were essentially unchanged from the results presented here, and transfers on their own entered into the estimations insignificantly.

male then this variable is equal to zero). The second estimation includes instead dummy variables reflecting different female income share categories. The categories of 40% to 60% and 60% to 80% are grouped together because the latter category perfectly predicts a probability of one of joining a rosca. The omitted category is a female income share equal to zero.

Variable	$\frac{\partial F}{\partial X}$	**S. E.**	$\frac{\partial F}{\partial X}$	**S. E.**
Female	0.222*	0.040	0.223*	0.040
Couple	-0.123*	0.050	-0.123*	0.050
Female×Couple	0.180*	0.073	0.176*	0.073
Food Expenses	-8.95e-06	1.2e-05	-8.93e-06	1.25e-05
(Food Expenses)^2	1.75e-10	7.65e-10	1.73e-10	7.65e-10
Female share of Couple Income	1.038*	0.199		
(Female share of Couple Income)^2	-1.097*	0.243		
Lived in Kibera for at most 2 years	-0.085*	0.030	-0.086*	0.030
Number of children	-0.0113	0.0087	-0.0115	0.0087
Primary school degree	-0.032	0.026	-0.032	0.026
Age	0.0543*	0.008	0.0546*	0.008
(Age)^2	-6.2e-04*	1.1e-04	-6.2e-04*	1.1e-04
Kikuyu	-3.4e-04	0.042	-3.9e-04	0.042
Luhya	0.0234	0.045	0.0221	0.045
Luo	0.0021	0.038	0.0017	0.038
Kamba	0.191*	0.077	0.193*	0.077
Female income share >0 & □20%			0.172	0.13
Female income share >20 & □40%			0.278*	0.071
Female income share >40 & □80%			0.301*	0.084
Female income share >80 & □100%			-0.048	0.083
Number of Observations	1267		1267	
Pseudo R^2	0.29		0.29	

Table 3: Probit estimation of rosca participation[24]

Being a female, and being the female member of a couple are important determinants of rosca participation. (Married males, on the other hand, are less likely to join a rosca, as represented by the significant and negative coefficient of the couple variable.) More importantly, female share of couple income is a significant determinant of rosca participation. The second estimation directly supports the inverted-U shape hypothesis, as predicted by our theory, where for a high female weight in household decision making, household savings are close to female savings and the need for a woman to join a rosca is less. This relationship is also found in the first estimation (higher

[24]In all tables, an asterix after the coefficient denotes signficance at the 5% level of the regressor.

order terms enter negatively and significantly). In the plot below, the predicted values of rosca participation rates from the first estimation are computed for varying female income shares and for the average levels of all other variables:

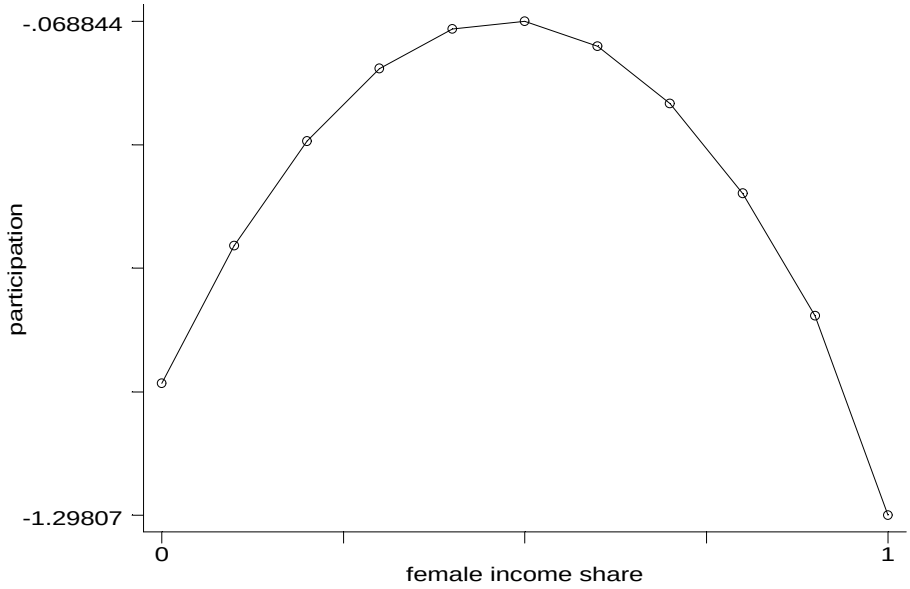

Figure 7: Female income share vs. predicted rosca participation

Most of the other results have the predicted sign, except for number of children which is negatively related, but insignificant. Perhaps surprisingly, the general wealth level of the household (represented by the expenditure on food) is insignificantly related to rosca participation, however, it is consistent with our theory; that it is the female's share of that income which is the important determinant. As would be expected, years spent in Kibera is a significant determinant of rosca participation, where individuals who have spent at most two years in the slum are less likely to join a rosca. Native language (or ethnic identity) is also significant, thus supporting the notion that familiarity and trust foster the possibility of informal collective arrangements. The age of individuals is significantly related to the probability of joining a rosca where higher order terms enter negatively into the estimation. If we plot the relationship between the predicted probability of joining a rosca and the age of individuals, the relationship is concave and begins to decrease at 35 years of age. These results coincide with the notion that individuals need time to establish themselves and to develop more long standing relationships with others, but also with the idea that

the demand for durables tends to be higher among younger individuals as found by Levenson and Besley (1996).

The second stage estimation regresses similar variables on total monthly rosca contributions of individuals. The variables to proxy for bonds and familiarity amongst group members (years spent in Kibera and ethnic identity) are left out of the determination of rosca contributions. We use these variables to identify the probability of joining a rosca in the first stage of the estimation. It is important to note that when these variables are included into the estimation of rosca contributions, they are in fact insignificant (see Appendix B). This supports the notion that, once individuals have formed their rosca groups, based on familiarity and trust, the actual amount of rosca contributions depends on other factors. Since we are analyzing the problem from the perspective of individuals rather than rosca groups, the dependent variable is the sum of contributions to all rosca groups that a given individual belongs to. The table below lists the results from the regression on total rosca contributions.

Variable	**Coeff.**	**S. E.**	**Coeff.**	**S. E.**
Female	186.6	245.3	134.5	220.8
Couple	245.4	257.1	258.0	262.7
Female×Couple	-481.2	293.9	-455.6	299.7
Food Expenses	.102	0.053	.107*	0.054
(Food Expenses)^2	-4.4 e-06	3.4 e-06	-4.67 e-06	3.45 e-06
Female share of Couple Income	1688.2*	650.3		
(Female share of Couple Income)^2	-1285.3	783.2		
Number of children	-45.2	34.4	-44.2	34.4
Primary school degree	-30.8	94.2	-36.2	94.7
Age	86.1*	43.3	78.0*	36.1
(Age)^2	-1.10	.58	-1.02*	0.51
Inverse Mill's ratio	821.1	1272.9	2662.2	6197.0
Female income share >0 & □20%			54.1	291.1
Female income share >20 & □40%			233.7	154.5
Female income share >40 & □80%			493.5*	173.8
Female income share >80 & □100%			134.6	327.1
Constant	-1167.6	736.0	-471.8	1402.0
Number of Observations	321		321	
$\overline{R}^2$	0.05		0.04	

Table 4: Estimation of rosca contributions

Once again, the estimates confirm our theoretical analysis, as female share in couple income is a significant and positive determinant of rosca contributions. Moreover, the second estimation

shows that the relationship is likely an inverted-U shape. This result is also supported in the first estimation if we plot the predicted values, as shown below.

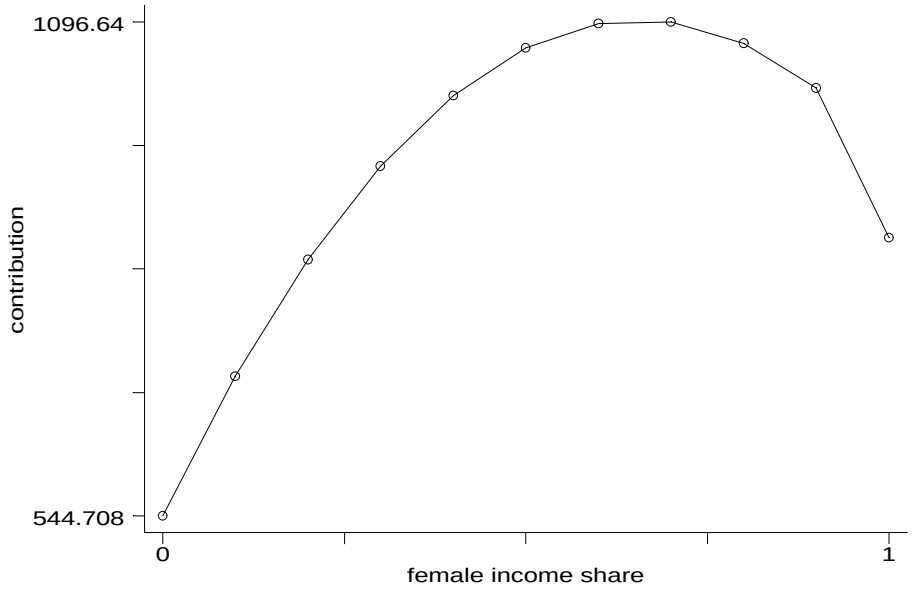

Figure 8: Female income share vs. predicted rosca contribution

It is interesting to note, that unlike the probit estimation, the general wealth level of the household (represented by the expenditure on food) is likely to be positively related, where higher order terms are negatively but not significantly (see, however, Appendix B) related to the amount of the contribution. That household income determines rosca contributions, but not participation as such, is in line with our theory. More strikingly, in contrast to the participation decision estimates, marital status and gender have no impact on the contribution amounts, as predicted by our analysis. The inverse Mill's ratio is not a significant determinant of total rosca contributions.[25] This suggests that the two decisions are in fact independent. In other words, individuals do not choose whether or not to join the rosca depending on the contribution amount. This may be because there are typically many different roscas to which an individual can participate, which allows for some flexibility in the amount contributed. Alternatively, it may be because many roscas are formed with a small number of individuals familiar to each other, who then negotiate together the amount of monthly contributions. The age of rosca participants is again significant and similarly, if plotted, follows a concave relationship.

[25]This result is further support against a tobit estimation.

Since there is no interest to be gained by saving in a rosca, it is not the case that joining a rosca directly increases the participant's income, and hence relative income share. However, it is plausible that joining a rosca indirectly increases an individual's income by facilitating beneficial social connections. As a result, a female's income share is potentially an endogenous regressor in the above estimates. However, the Hausman test rejects this potential endogeneity when we use the difference in total years employed in present occupation between the wife and husband to instrument for a wife's relative income share. It makes sense that this variable, which proxies for relative job stability, should affect relative bargaining power within the household but not necessarily directly affect income. In any case it is an insignificant determinant of rosca participation and contributions and a significant determinant of female income share.

We also ran identical estimations to the above, where instead of female share in couple income, we entered the work status of married females into one estimation, and married females' individual income into another. Identical results ensued, where both of these indicators of females' household bargaining power entered positively and significantly into both estimations, with higher order terms of individual income negatively related to both rosca participation and the amount of contributions. These results are listed in Appendix B.

5. An alternative explanation

A related motivation for rosca participation is that money kept at home is more vulnerable to unexpected demands for help by relatives. Traditional solidarity networks usually pressure well-to-do households to provide financial support to their less fortunate relatives (see, for example, Platteau (2000)). In these circumstances, rosca participation can then be used as a way to render savings illiquid and better allow the household to resist these demands in a socially acceptable way.

Suppose a household faces a probability, p, at each period, of being asked to give their savings to a relative in need (and, as before, no one has access to formal credit markets). To keep the discussion simple, assume that the household saves a constant amount s for t periods in order to purchase an indivisible good which costs D, hence $D = ts$. It has a choice between accumulating savings at home or joining a rosca. Although it seems clear that, when putting their savings in a rosca, the money is safe from being stolen, however, what is still a concern is that when returning home with the pot, they risk losing the entire sum of their savings by an unexpected claim. This

expected loss is equal to pD. If they were to save at home, their expected loss in the last period is similarly equal to pD. However, in addition to this risk, their expected loss in each period τ is equal to τps. Therefore the total expected loss over all periods is necessarily larger than pD. In consequence, it is always worthwhile to join a rosca.

With a positive discount rate, however, the optimal saving rate is increasing, whereas in a rosca the savings rate is constant. Therefore given the inflexibility of the saving scheme under a rosca, one might argue that joining a rosca is not worthwhile if the probability of claims is sufficiently low. However, this is not the case since the household is still strictly better off by joining a rosca for which the contribution is equal to their optimal first period savings, (i.e., the lowest amount), while accumulating increasing excess savings at home. In such a scenario, the risk related to an unexpected claim for help from a relative is thereby reduced. Note also that we are assuming that the probability, p, is independent of the amount. But it is clear from the above reasoning that this assumption is immaterial to our main point, but it implies that rosca participation is more likely the richer the household.

This story however is not consistent with our empirical findings. Indeed, if this constituted the main motive behind rosca participation, then income, rather than female share in household income, should be the main determinant of rosca participation. By contrast, the fact that rosca members are predominantly female can be consistent with the story above given that the division of labour within African households could entrust women with the management of household savings. An even simpler explanation, also based on a desire for an illiquid saving mechanism, is to conceive p as the probability of theft. In this case, to explain the predominance of married female participation, we could consider that the main source of risk is the husband. This notion may seem far-fetched but anecdotal evidence from interviews suggest that women seriously consider this matter. More generally, it is fairly common in Africa for women to accumulate assets independently and unbeknown to their husbands. However, in any case, neither of these interpretations can fully explain the importance of a woman's relative income share in determining rosca participation and contributions.

6. Conclusion

The present paper is based on detailed field observations of informal saving groups in the slum of Kibera (Kenya). The starting point of our analysis is the observation that married women with a regular income earning occupation were the most likely to participate in a rosca. To explain this phenomenon, we propose a new argument based on differential consumption choices between wives and their husbands. If women tend to prefer higher saving rates than the one chosen by the household, they will use roscas to accumulate more savings. Even though, *ex ante*, her husband and other members in the family would have preferred her not to start saving through a rosca, they may *ex post*, once she receives the pot, agree with her plan to spend the accumulated savings. Participation in a rosca thus increases woman's welfare at the expense of her husband. We also show that rosca participation and contributions follow an inverted-U relationship with woman's bargaining position within the household. The empirical tests carried out on our original data set give support to this explanation.

7. Appendix A: Constitutions of informal groups in Kibera (excerpts)

7.1. Adundo Women Group

(...) Each member contributes 150 KSh for each meeting. With the contributions, the Organizing Lady buys things for the house in which the meeting is being held.

(...) Meetings are held every Sunday from 3 pm to 5 pm. (...)

All members must attend the meetings. The fine for not coming is 30 Ksh, even if the member has an excuse.

7.2. Kibera Nyakwerigeria Group

Motto: *Forward ever, backward never*

Introduction: The vision of the forming of the group came on the 8th day of October 1995, when a team of group members sat down with a main theme of:

Forming Nyakwageria group so as to uplift the standard of living by each member contributing Ksh 500 to one member on every sunday of the week in a style of merry-go-round, and a monthly contribution of Ksh 200 from every member towards the group to be put in an interest earning account with a view to commencing projects of the group.

For the mutual welfare and successfully running of the group, the following *rules and regulations* were set down:

1. On every sunday every week, the programme will start at exactly 2.30 pm with a prayer and the meeting will close at exactly 3.30 pm with a vote of thanks from the chairman.

2. Every member must attend all the Sunday meetings and absenteism will be only accepted with apology.

3. If a member misses to attend a meeting and without even sending his/her contribution, committee members must establish the cause of his/her absence with immediate effect.

4. No member or anybody from outside is allowed to bring another member's contribution when she/he is absent. For members who are parents, a son or daughter is allowed to bring the contribution and for bachelors or spinsters, a close relative can be allowed to attend and contribute.

5. Late comers will pay a fine of kshs 50.

6. If any member misses for three consecutive meetings without any proper reason, he/she will be expelled from our group.

7. Any office bearer who goes contrary to the rules and regulations of the group will be put off. (...)

10. Stern action will be taken against any member who may run away with members money. (...)

14. For new members to join, all group members must be informed and they must consent to the same. (...)

May God bless our group abundantly and let him be our guider in everything we do.

7.3. Garden Women Group-Kibera-Kianda (Nairobi)

(...) 2. Weekly meeting every saturday at exactly 2 pm.

3. Fine for lateness is 10/= up to 3 pm but coming to the meeting after 3 pm is 20/=.

4. Contribution for each house (Mary-go-round) is 50/= for each member. (...)

8. There should be no exchange of words or fighting within members when we are in the meeting.

9. Members should not wear trousers during the meeting.

10. No member should come to the meeting when drunk.(...)

13. End of the year party

a. Every member is to attend this party during which we utilize the funds collected from the Fines' Account for buying sodas.(...)

c. Every member should make use of her money wisely, the first priority being buying books, uniforms etc. for our school children.

7.4. Tumaini Women Group

(...) *Punctuality*

All members must be punctual. All meetings will begin at 2.00 pm with an allowance of fifteen minutes after which anyone who is late will pay a fine of Ksh 20.(...)

Secrecy

Members must maintain a high level of *secrecy* and nothing discussed in the meeting should be repeated elsewhere or discussed with non-members. All issues discussed should be treated as

confidential.

8. Appendix B

8.1. Estimation of rosca contributions including trust proxy variables

From the table below, we see that the variables which identify the probit estimation are indeed insignificant determinants of rosca contributions.

Variable	**Coefficient**	**S. E.**
Female	53.41	220.75
Couple	258.07	253.92
Female×Couple	-467.71	294.02
Food Expenses	0.101	0.0536
(Food Expenses)^2	-4.39e-06	3.43e-06
Female share of Couple Income	1405.785*	608.68
(Female share of Couple Income)^2	-1021.32	753.65
Number of children	-44.58	35.05
Primary school degree	8.52	97.70
Age	57.24	36.40
(Age)^2	-0775	0.507
Lived at most 2 years in Kibera	-51.29	173.72
Kikuyu	239.06	169.56
Luhya	60.93	177.67
Luo	24.90	154.49
Kamba	41.84	224.24
Constant	-710.82	682.89
Number of Observations	321	
$\overline{R}^2$	0.045	

8.2. Alternative probit estimates of roscas participation

Dependent variable: participation to at least one rosca

Variable	$\frac{\partial F}{\partial X}$	S.E.	$\frac{\partial F}{\partial X}$	S.E.	$\frac{\partial F}{\partial X}$	S.E.
Female	.226*	.040	.223*	.040	.222*	.040
Couple	-.120*	.050	-.121*	.050	-.125*	.050
Female×couple	.178*	.073	.176*	.073	.224*	.073
Food Expenses			-8.1 e-06	1.2 e-5	-7.8 e-06	1.3 e-05
(Food Expenses)^2			1.52 e-10	7.6 e-10	1.1 e-10	7.7 e-10
Household income	9.4 e-07	1.69 e-06				
(Household income)^2	-2.1 e-11	4.1 e-11				
Female share in couple income	1.01*	.199				
(Female share of couple inc.)^2	-1.07*	.243				
Number of children	-0.016	.008	-.012	.009	-.010	.009
Primary school degree	-.034	.026	-.029	.026	-.036	.026
Age	.055*	0.008	.054*	.008	.055*	.008
(Age)^2	6.4 e-4*	1.1 e-4	-.001*	.000	-6.3 e-04*	1.2 e-04
Lived at most 2 years in Kibera	-.086*	.030	-.083*	.030	-.088*	.030
Kikuyu	-.000	.042	-.003	.042	-.011	.041
Luhya	.028	.046	0.17	.044	.016	.045
Luo	.006	.038	-.001	.038	.004	.038
Kamba	.199*	.077	.177*	.076	.168*	.076
Working female×couple			.233	.055		
Female income×couple					2.9 e-05*	8.1 e-06
(Female income×couple)^2					-3.1 e-10*	1.4 e-10
Number of observations	1267		1267		1267	
Pseudo R^2	.284		.281		0.276	

8.3. Alternative OLS estimates of Rosca Contributions

Dependent variable: amount of individual monthly contribution to rosca(s)

Variable	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
Female	236	249	91.3	253	2.98	240
Couple	144	258	295	260	345	257
Female×couple	-323	295	-491	296	-554	304
Food expenses			.108*	.054	.103	.054
(Food expenses)^2			4.7 e-06	3.4 e-06	-4.6 e-06	3.4 e-06
Household income	.009	.007				
(Household income)^2	-5.9 e-08	1.5 e-07				
Female share of couple income	1915*	656				
(Female share of couple inc.)^2	-1619*	795				
Number of children	-28.8	33.3	-43.4	34.3	-31.7	33.9
Primary school degree	-19.8	94.1	-11.4	94.6	-35.6	93.7
Age	98.5*	43.9	71.6	45.5	44.7	46.2
(Age)^2	-1.20*	.582	-.937	.602	-619	.606
Mills ratio	1981	1270	-106	1381	-871	1244
Working female×couple			318*	151		
Female income×couple					.068*	.018
(Female income×couple)^2					-7.6 e-07*	2.5 e-07
Constant	-1086	736	-980	764	-498	783
Number of observations	321		321		321	
$\overline{R}^2$	.040		.038		0.06	

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